

IMPACT OF FARMYARD MANURE AND MANURE COMPOST TEA ON POTATO YIELD AND SOIL FERTILITY.

El-Tantawy, I.M.; A. M. El-Ghamry and A. H. Habib.

Soil Dept, Faculty Agric., Mansoura Univ., Egypt.

ABSTRACT

A field experiment was conducted during the successive season of 2004/2005 winter in using clayey soil at Monshat El-Badawi Village, Talkha District, Dakahlia Governorate (North Nile delta region), to investigate the ability of applying farmyard compost and its compost tea on potato crop (*Solanum tuberosum* L.) cultivar Spunta and economic return for each treatments. Five treatments were arranged in a complete randomize block with three replicates, Four application methods (ore compost, sediment, sediment and extract combination and compost tea). Compost tea, foliar significantly increased dry shoot yield and fresh tuber yield in both seasons. Also, application of compost tea increased dry matter (as %), crud protein (as %) and specific gravity of tubers in both seasons. As so, sediment and extract combination addition increased dry matter (as %) in tubers, and crud protein (as %) significantly in both season.. The addition of farmyard manure into the soil increased both of total and available nitrogen, phosphorus and potassium in the soil. In spite of the highest values for all studied parameters under investigation were realized due to the compost tea treatment.

INTRODUCTION

Organic farming systems that are based on three practical pillars; (1) the maintenance and increase of soil fertility by the use organic manures;(2) the omission of synthetic fertilizers and synthetic pesticides; (3) the lower use of high energy consuming feedstuff (FlieBbach, *et al.*, 2006 and El-Wehedy 2008). The organic matter content of the Egyptian soils is usually less than 2% in cultivated area. Frequent and high application of organic manure are necessary to maintain soil fertility. In Egypt farmyard manure is usually used as organic fertilizer. This organic fertilizer vary greatly in their composition. Generally, soil organic matter is considered as an important factors for improving physical, chemical and biological properties of soil (Abd-el moez *et al.*,1999).

Compost tea, in modern terminology, is a compost extract brewed with a microbial food source molasses, kelp, rock dust, humic and fulvic acids. The compost tea brewing technique, an aerobic process, extracts and grows populations of beneficial micro-organisms. Compost tea was used as the source of organic substances. As so in recent years, compost tea have emerged as an important component of the integrated nutrients supply system and hold a great promise to improve crop yields through environmentally better nutrient supplies. Extracts of the finished composts were reduced bacterial toxicity. Ana *et al.*, (1995) showed that is the best quality compost from a fertilizer perspective was starting from an initial C:N ratio equal to about 20:1, but starting from this C:N ratio could bring problems with the content of cadmium, so the recommended starting conditions must

be about 30:1. However, the application of compost tea in practice, somehow, has not achieved constant effects.

The effect of organic manure on plant behavior is not just a matter of nutrients supply, but also organic materials influences the physical, chemical and biological characteristics of soil which in turn influences development of plants. Makaraviciute (2003) illustrated that farmyard manure (FYM) application increased dry matter and starch contents in the tuber, where potato tuber yield increased by 20 % with FYM. The response of tuber yield to farmyard manure was not consistent over growing season, possibly the positive yield response was due to K rather than N. Therefore, the main objectives of the present study is to evaluate the effect of soil and foliar farmyard compost and compost tea applications on quality and quantity of potato crop and how is the effect on soil fertility.

Potato (*Solanum tuberosum* L.) is one of the most important vegetables in Egypt. It gained a considerable importance as an export crop to European markets and one of the national income resources. Potatoes require high amounts of nitrogen, phosphorus and potassium fertilizers for optimum growth, production and tuber quality.

MATERIALS AND METHODS

A field experiment was conducted during the successive growing season of winter 2004/2005 on potato (*Solanum tuberosum*, L.) cultivar Spunta. Soil analysis has been carried out according to (Jackson, 1967).

Table (1): Some soil properties of the studied soil

property	Mechanical analysis				Physico properties						
	Sand %	Silt %	Clay %	texture	SP %	OM %	CaCO3 %	pH	EC dSm-1		
Values	14.01	25.97	60.02	Clayey	79.93	1.39	2.77	7.4	1.63		
property	Soluble Cations (meq/L soil)				Soluble Anions (meq/L soil)				Available nutrients (p		
	Ca ⁺⁺	Mg ⁺⁺	K ⁺	Na ⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻	N	P	K
Values	2.46	2.39	0.31	0.87	0.00	0.79	2.27	2.97	37.16	9.03	365.17

Table (2): Some chemical properties of FYM:

FYM	pH*	EC** dS/m	O.C. %	Total N %	C:N ratio	Total K%	Total P %	Adding rate
Ore Compost	8.61	0.64	29.06	6.89	32.65	0.47	0.36	13.48 (t/fed)
Extract	7.70	0.41	9.47	0.53	17.87	0.33	0.29	22.64 (L/fed)
Sediment	8.12	0.58	21.83	0.48	25.00	0.09	0.14	25.00 (t/fed)

*pH was measured in 1: 1suspension for FYM ** EC was measured in (1: 1) water extract of FYM.

The experiment was designed in a complete randomize block with 3 replicates Treatments were as follow: (ore compost, sediment, sediment and extract combination and compost tea). The ore compost and the sediment were applied before the last tillage, then soil was irrigated and left for 14 days before planting. Control plots received the recommended dose by the ministry of agriculture for the N, P and K nutrients. Calcium super-phosphate was

applied before planting irrigation at the rate of recommended dose of (75kg P₂O₅/fed) for all treatments. Ammonium nitrate fertilizer was applied at the rate of recommended dose (120kg N/fed) in two doses, the 1st dose was added with the 1st irrigation and the 2nd dose with the 2nd after planting. Potassium was applied in one dose with the 2nd irrigation after planting at the recommended dose (95kg K₂O/fed). Compost tea was applied as foliar application on plant shoot at 2 times after 45 and 60 days from planting. Potatoes plants were irrigated 7 irrigations after planting. Potatoes were harvested after 110 days from planting date. Potato tuber pieces were planted in October 13th 2004 and harvested in January 28th 2005, and the following parameters were recorded at the midseason and harvest stages: (1) Fresh tubers yield (t/fed). (2) Tuber quality parameters: dry matter (%) ; specific gravity and crud protein (%). (3) Chemical constituents: N, P and K (%) were determined in leaf, stem and tuber dry matter according to (Jackson, 1967). (4) Soil chemical properties: total and available nitrogen, phosphorus and potassium was determined, as described by (Hesse, 1971).

The statistical analysis of the obtained data was done according to the methods described by (Gomez and Gomez, 1984) using LSD to compare the means of treatments values.

RESULTS AND DISCUSSION

The discussion will include the effect of soil and foliar applied of farmyard manure compost and compost tea on yield, yield quality, chemical constituents of N, P, K and some soil chemical properties.

1-Plant Growth:

Plant Height:

Data in Table (3) illustrate that the effect of farmyard compost tea applications on the potato plant and showed that control treatment was the highest value as it was 51.38cm. And with applying farmyard compost tea, plant height increased significantly from 40.79cm with the ore compost to be 47.12cm with compost tea. Sediment. As the sediment with extract treatments gave a moderate values as they were 42.91 and 44.32cm, respectively. These results are in agreement with those obtained by: El-Dissoky (2008) and El-Shazly (2008).

Leaf Area:

Data in table (3) indicated that there were a significant differences between the composts tea and the control treatment. The superiority was due to composts tea in the foliar forms. Mineral fertilizers (control treatment) obtained (0.3289m² plant⁻¹). The values of leaf area (m² plant⁻¹) were (0.3355m² plant⁻¹) with farmyard compost tea. Also, data illustrated the significantly differences in the leaf area between the various treatments. The value of leaf area with farmyard sediment and compost tea was (0.3200m² plant⁻¹). As obtained in the table, sediment leaf area value was (0.3098m² plant⁻¹). But the ore compost had lowest record where gave (0.2904m² plant⁻¹). These effects of organic manures on potato leaf area may be related to the important role of Nitrogen, Phosphorus and Potassium in the plant tissues

that reflect on vegetative growth. they plays vital role in photosynthesis, carbohydrate transport, protein formation, control of ionic balance, regulation of plant stomata and water use activation of plant enzymes and other processes, El-Sawy, *et al* (2000), El-Dissoky (2008) and El-Shazly (2008).

Table (3): Effect of applying farmyard manure compost and compost tea on potato plant height (cm), leaf area (m²), leaves fresh weight (gm) and stem fresh weight (gm).

Parameter	Plant Height (cm)	Leaf Area (m ²)	Fresh Yield (ton/fed)	Tubers humidity (%)
Control	51.38	0.3289	13.19	76.85
Ore Compost	40.79	0.2904	11.23	70.91
Compost Tea	47.12	0.3300	14.00	77.24
Sediment	42.91	0.3098	11.96	73.03
Sed. + ext.	44.32	0.3200	12.73	74.44
LSD 5%	0.4380	0.2279	0.1140	0.2890

2- Tubers quality:

Yield Fresh Weight:

Concerning the effect of organic manures treatments on fresh tuber yield weight, data in table (3) reveal that fresh tuber yield (ton fed-1) were significantly increased when potato was treated with farmyard manure tea as compared to the control. The control treatments amounted to about (13.19 tonfed-1). The highest mean value of tuber yield was (14.00ton fed-1) obtained from plots treated with farmyard compost tea. Meanwhile, the lowest mean value of previous attribute was (11.23ton fed-1) obtained from applying the untreated farmyard compost (ore compost), (11.96 ton fed-1) with the sediment and (12.73ton fed-1) when adding the extract with the sediment (50% ext. + 50% sed.). Generally, the beneficial effects of farmyard manure on tuber yield might be related to improved the physical conditions of the soil, provided energy for microorganisms activity, increased nutrient supply and improved the efficiency of macro elements, El-Shazly (2008).

Tubers humidity percentage (%):

Referring to the effect of organic manures, differences between the organic applications were high significant. Considering mean values of humidity percentage of tubers, data in table (3) could be observed that values of the relative increase over the compost tea treatments using watery extracts of farmyard compost was (77.24%). The mineral fertilizers (control treatment) given a high value of humidity percentage which was (76.85%). However, the addition of organic manures increase tuber humidity percentages at harvest (after 110 days after planting). The minimum mean values of tuber humidity percentage was (70.91%) which obtained from the addition of farmyard ore compost. Whereas the percentage of tuber humidity gone higher twice. Firstly with applying sediment which was (73.03%). Secondly heightens was occurred with the combination between sediment and extract, as the value was (74.44%).

Tuber humidity due to the ability of the inner tissues for storing water molecules between cells, this ability was improving by the roles of essential

nutrients in encouraging cell elongation and cells divisions which increasing the vegetative parameters and activation of metabolic which reflected increases in tissues buildings and improving walls permeability for water and solution transportations. These effects of farmyard, sheep and chicken manures on humidity percentages in tubers are in accordance with those reported by El-Banna *et al.*, (2001), El-Dissoky (2008) and El-Shazly (2008).

3- Chemical constituents in potato plant leaves:

Nitrogen:

As obtained in Table (4) nitrogen concentration in midseason increased from (3.75%) with farmyard ore compost to (4.07%), (4.35%) and (4.61%) with the sediment, combination between sediment and extract and compost tea of farmyard manure. Control treatment occurred a moderate means which were (3.37%).

On the other hand, nitrogen concentration in potato leaves was affected in the harvest. Data illustrated in table (4) reported that concentrations increased from (1.36%) with farmyard ore compost to (1.64%), (2.00%) and (2.36%) with sediment, combination and compost tea, respectively. As the control treatment occurred an average values which were (2.08%)

These results may be attributed to the high capacity of the plants received such treatments in building metabolites which reflect on more vigorous plant growth and rooting system which in turn contributes to increase in nitrogen concentration. These results are in accordance with those obtained by Abou-Hussein (2005), Selim and El-Mancy (2007) and El-Shazly (2008).

Phosphorus:

Concerning to the effect of farmyard compost treatments on phosphorus concentration in potato leaves, data in Table (4) reveal that, there was a general increase in phosphorus values and its content with treating of farmyard compost tea better than the other applications to potato plants at 70days after planting. Data in table (5) pointed out that phosphorus content in potato leaves at the midseason stage was (0.96%), (1.101%), (1.04%) and (1.11%) with the farmyard ore compost, the sediment, the combination and the compost tea, respectively. As control treatment occurred a moderate means which were (1.08%).

Similarly, The mean values of phosphorus concentration in potato leaves at the harvest stage become higher from (0.245%) at ore compost from farmyard manure, to be (0.385%) at sediment treatment, (0.487%) when treating by combination between sediment and extract and were (0.650%) with farmyard compost tea.

Mineral fertilizers (control treatment) occurred (0.581%) in phosphorus concentration in potato leaves. And regarding to the statistical analyses for the data reported during the experiment seasons, it is clearly that there is a high significantly differences among the organic applications and the inorganic treatment.

Table (4): Effect of applying farmyard manure and manure compost tea on Leaves Nitrogen, Phosphorus and Potassium at the midseason and harvest times.

Parameter	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	midseason	harvest	Midseason	harvest	midseason	harvest
Control	4.37	2.08	1.08	0.081	6.73	4.60
Ore Compost	3.70	1.36	0.96	0.240	5.61	3.71
Compost Tea	4.61	2.36	1.11	0.600	6.78	4.63
Sediment	4.07	1.64	1.01	0.380	5.98	3.90
Sed. + ext.	4.30	2.00	1.04	0.487	6.39	4.19
LSD 5%	0.0892	0.0792	0.114	0.111	0.1168	0.1140

Potassium:

Regarding the effect of farmyard compost treatments on potassium concentration in potato leaves, data in Table (4) obtained that, there was a general increase in potassium values and its content with treating of farmyard compost tea better than the other applications to potato plants at the midseason stage.

As obtained in Table (4) potassium concentration in midseason, control treatment presented a moderate value which was (6.73%).

About the midseason potassium concentration, data in the table reported that there is an increasing from (5.61%) with farmyard ore compost to (5.98%), (6.39%) and (6.78%) with the sediment, combination between sediment and extract and compost tea of farmyard manure, respectively.

Data in the same table showed that potassium content in potato leaves at the harvest stage were (4.60%) with applying the minerals fertilizers as control treatment. The statistical analysis of potassium concentrations data at the harvest stage indicate that applying the farmyard manure significantly increased the differences among the treatment and the control. With farmyard treatments, data in table (4) revealed that values were (3.71%), (3.90%), (4.19%) and (4.63%) with farmyard ore compost, sediment, combination and compost tea, respectively.

3- Chemical constituents in potato tubers:

Data presented in Table (5) showed the effect of applying farmyard compost and compost tea on nitrogen, phosphorus and potassium concentration in potato tubers. Data showed that the applications gave differences with a high significant values in nitrogen, phosphorus and potassium percentages in tubers with the application methods in the experimental seasons.

Nitrogen (%):

Results in table (5) showed the mean values of total nitrogen percentages in potato tubers as affected by adding the experimental manures. Control treatment gave concentrations as (1.20%). The mean values of nitrogen concentration affected by the other treats were (0.55%), (0.81%), (1.00%) and (1.22%) when farmyard manure added as the ore compost, sediment, combinations between sediment and extract and compost tea, respectively.

Table (5): Effect of applying farmyard manure and manure compost tea on tuber Nitrogen, Phosphorus and Potassium at the midseason and harvest times.

Parameter	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Control	1,20	0,86	3,08
Ore Compost	0,00	0,04	1,69
Compost Tea	1,22	0,91	3,23
Sediment	0,81	0,71	2,17
Sed. + ext.	1,00	0,80	2,83
LSD 5%	0,0886	0,0339	0,1087

It could be noticed that the means of absorbed nitrogen by potato tuber tissues were higher than the means of absorbed nitrogen by potato top tissues at the different growth stages. These results could be enhanced by those obtained by El-Shazly (2008).

Phosphorus (%):

Regarding the effect of using farmyard manures to potato planted in the experiment on phosphorus concentration in the tubers, it was a high significant differences in phosphorus content as influenced by adding farmyard manure.

Phosphorus percentages were clearly shown in table (5), as increased from (0.54%) with ore compost, to be (0.71%) with sediment. So the same tend were happened when using combination, as it increased to be (0.80%). The highest value was (0.91%) as treated by compost tea. Control treatment had lower concentration in tuber's phosphorus than that treated plots by compost tea, it was (0.86%).

Potassium (%)

The influence of farmyard manure on potassium concentration in potato tubers in the present experiment which are occurred also in table (5), data in the table showed the values of the farmyard manure treatments which gave (1.69%) total potassium in the potato tubers when added as farmyard ore compost. So the treated plots with sediment had the higher values, as it increased the potassium percentage to be (2.17%). Whereas using combination treatment had more higher potassium concentration than pervious treatments, which was (2.83%). But lower than the compost tea treatment which occurred (3.23%).

The steady release of the nitrogen, phosphorus and potassium from farmyard manure may have resulted that they have been taken up mainly in the form of available forms which probably caused nutrients accumulations in the plants tissues (Kolbe *et al.*, 1995). Our results are in accordance with those reported by El-Banna *et al.*,(2001), Tawfik (2001); Awad (2002); El-Mancy and Selim (2007) and El-Shazly (2008).

4-Soil fertility:

Nitrogen :

There is no doubt that nitrogen concentration and availability in the experimental soil will be increased due to applying organic fertilizers enriched in nitrogen. Data presented in table (6) revealed that the values of total nitrogen content was differenced clearly when farmyard manure added to the

soil, as it was (1.30%) when the farmyard manure added as an ore compost, for plants at midseason. They were decreased highly significant with applying as a sediment, combination or as a farmyard compost tea to be (1.10%), (0.58%) and (0.13%), respectively.

Talking about total nitrogen concentration in potato experimental field at the harvest stage, data reported in table (6) that there is a significant differences among the treatment in total nitrogen concentration as influenced by applying organic manure.

Table (6) pointed out that total nitrogen concentrations in potato field at the harvest stage were (0.61%), (0.43%), (0.25%) and (0.09%) with the farmyard ore compost, the sediment, the combination and the compost tea, respectively. When applying the fertilizers as minerals in the control treatments, means were (0.18%).

Table (6): Effect of applying farmyard manure and manure compost tea on soil total Nitrogen, Phosphorus and Potassium at the midseason and harvest times.

Parameter	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	midseason	harvest	midseason	harvest	midseason	harvest
Control	0.27	0.18	0.44	0.17	0.67	0.38
Ore Compost	1.30	0.61	0.63	0.48	0.98	0.69
Compost Tea	0.13	0.09	0.11	0.07	0.37	0.24
Sediment	1.10	0.58	0.48	0.37	0.79	0.50
Sed. + ext.	0.58	0.25	0.33	0.21	0.58	0.39
LSD 5%	0.10	0.07	0.13	0.09	0.18	0.13

Phosphorus:

Pointing to the total and the available phosphorus concentrations in potato experimental soil, they are found in Table (6). Data obtained were clearly showed that both total and available phosphorus were differenced significantly in potato field with applying various types of organic manures.

Farmyard manure added caused highly significant differences in total phosphorus percentage in the experimental soil at midseason stage, these levels were (0.63%) with farmyard ore compost, and (0.48, 0.33 and 0.11%) with sediment, combination and compost tea, respectively. Control treatment values were (0.44%). However these value was decreased at harvest to be (0.17%).

Total phosphorus concentration in experimental field at the harvest stage were stated in table (6). They were, (0.48, 0.37, 0.21 and 0.07%) as affected by the farmyard ore compost, sediment, combinations and compost tea, respectively.

Potassium:

There is a high significant reduction in potassium concentrations of both total and available forms as influenced by farmyard manure in the experimental field reported also in Table (6). Data observed show that in both total and available phosphorus were differenced high significant with applying various types of organic manures in potato field. Control treatment values were (0.67%) when the plants get midseason.

Data reported in table (6) potassium percentage obtained as (0.98%) when the farmyard manure added as an ore compost, for plants at midseason. They were decreased highly significant with applying as a sediment, combination or as a farmyard compost tea to be (0.79%), (0.58%) and (0.37%), respectively.

Regarding to effect of adding organic fertilizers on available potassium Farmyard manure applied could cause a high significant differences in total potassium percentage in the experimental soil at harvest stage, these levels were (0.69%) with ore compost, and (0.55, 0.39 and 0.24%) with sediment, combination and compost tea, respectively.

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أثر إضافة السماد البلدي ومستخلص الكمور علي محصول البطاطس وخصوبة التربة.

إبراهيم محمود الطنطاوي ، أيمن محمد الغمري و أحمد حسن محمد عبد الرحيم حبيب.
قسم الاراضى- كلية الزراعة – جامعة المنصورة – مصر

- أجريت تجربة حقلية خلال الموسم الشتوي لعام ٢٠٠٤/٢٠٠٥ في قرية منشأة البدوي بمركز طلخا - محافظة الدقهلية لتقييم تأثير السماد البلدى فى صور مختلفة حيث يتم إضافته أرضياً علي الصورة الصلبة وورقيا للصورة السائلة الناتجة عن استخلاص الكمور علي محصول البطاطس صنف سبونتا و التربة. وكانت النتائج كما يلي:-
- ١- تسببت معاملة نباتات البطاطس بمستخلص الكمور إلى زيادة ارتفاع النبات ونسبة الرطوبة في الأوراق والسيقان وعدد الأوراق وكذلك في المساحة الورقية والكلوروفيل.
 - ٢- أدت إضافة الأسمدة العضوية الصلبة إلى التربة إلى زيادة تركيز كل من النيتروجين والفسفور والبوتاسيوم في التربة في الصورتين الكلية والميسرة.
 - ٣- وجد أن أعلى القيم المتحصل عليها نتجت من إضافة مستخلص الكمور.
 - ٤- أدى إضافة الأسمدة العضوية على عمق ٢٠ سم إلى زيادة تركيزات المغذيات الكبرى.
 - ٥- أدت الأسمدة العضوية المضافة إلى زيادة المحصول الكلي ورطوبة الدرنات وكذلك ارتفعت نسبة البروتين الخام والنشا والكثافة النوعية في الدرنات بعد معاملة النباتات بمستخلص الكمورات.
 - ٦- ارتفعت تركيزات النيتروجين والفسفور والبوتاسيوم ارتفاعا حادا في الدرنات بزيادة مستويات مستخلص الكمور.
 - ٧- يرتفع محتوى مستخلص الكمور من المغذيات الكبرى بناء علي محتوى الأسمدة العضوية عليها.